Letter Health Consultation

WATERBURY ARTS MAGNET SCHOOL

WATERBURY, CONNECTICUT

Prepared by the
Connecticut Department of Public Health

SEPTEMBER 22, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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LETTER HEALTH CONSULTATION

WATERBURY ARTS MAGNET SCHOOL

WATERBURY, CONNECTICUT

Prepared By:

State of Connecticut
Department of Public Health
Under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry

STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

September 16, 2009

Pat DeRosa
Remediation Division
Bureau of Water Protection and Land Reuse
CT Department of Environmental Protection
79 Elm Street
Hartford, CT 06106

Dear Ms. DeRosa,

As we discussed, this letter provides documentation for an alternative, site-specific target indoor air concentration (TAC) for trichloroethylene (TCE), for use at the Waterbury Arts Magnet School (WAMS), located at 118 East Main Street, in Waterbury, CT. This letter also provides an evaluation of current exposures to TCE at the school. Target indoor air concentrations are chemical-specific concentrations in indoor air of homes or workplaces that are not expected to cause adverse health effects from long-term exposure. TACs also consider background indoor air concentrations, odor concerns, and quantification limits. TACs are not regulatory standards *per se*, but are used to back calculate regulatory standards for groundwater and soil vapor, considering the soil volatilization exposure pathway.

Background and Statement of Issue

The Waterbury Arts Magnet School for children in grades 6-12, consists of an academic building and a performing arts center building. Prior to construction of the school in 2002, environmental investigations identified the presence of "urban fill" on the property, containing volatile organic compounds (VOCs), total petroleum hydrocarbons (TPH), semi-volatile organic compounds and some heavy metals. Environmental investigations also indicated that groundwater beneath the property was contaminated with VOCs and TPH. Fill materials were generally removed from the property as part of soil remediation that occurred prior to construction of the school. No on-site sources for the groundwater contamination have been identified. The school was constructed in 2002 without a subslab soil vapor ventilation system because contaminant concentrations in groundwater and soil vapor were not elevated above state standards in place at that time (HRP September 2008, December 2008, February 2009).

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In October 2007, the consultant working on behalf of the property owner sampled indoor air in the basement of the two WAMS buildings because the concentration of trichloroethylene (TCE) in groundwater slightly exceeded new CT regulatory standards that were proposed in 2003. All of the indoor air samples exceeded CT's Residential and Industrial/Commercial TAC for TCE (1 ug/m^3). The greatest exceedance was slightly more than 4 times above the TAC. Over the following fourteen months, two additional rounds of indoor air testing, four rounds of outdoor air testing and several rounds of groundwater and soil vapor testing were completed in an effort to understand the source of TCE in indoor air (i.e. outdoor air, groundwater volatilization, or both). The body of environmental data collected at the school strongly suggest that both outdoor air and groundwater/soil vapor are contributing to indoor air TCE levels. Two of the four rounds of outdoor air data indicate that outdoor air contributions could be significant. However, no source of TCE in outdoor air was definitively identified. Outdoor air TCE levels were highly variable across the different sampling events. Groundwater and soil gas data indicate that the groundwater-soil volatilization pathway cannot be ruled out as a contributor to indoor TCE levels in the WAMS.

In May 2009, the CT Department of Environmental Protection (CT DEP) asked the CT Department of Public Health (CT DPH) to calculate an alternative TAC for TCE that would be appropriate for a school setting. Residential TACs assume exposure occurs 24 hours per day, 365 days per year. Exposure frequency and duration is less in a school setting. The alternative TAC will be used as a benchmark for evaluating the complete dataset of indoor air data from the WAMS and will help guide CT DEP toward a decision about next steps for the school.

Discussion

CT DPH used the general TAC risk assessment methodology (CT DEP 2003) to derive alternative TACs for exposure to TCE in the WAMS. As specified in the CT DEP methodology, TACs are based on a *de minimis* (one in one million) excess cancer risk or a hazard quotient of one for non-cancer effects. Students and teachers/school staff were evaluated separately. TACs were also derived separately for cancer and non-cancer effects. Exposure was assumed to occur 180 days per year (the length of the school year). Adjustments were also made to account for the amount of time spent in school (8 hours per day versus 24 hours per day). Modifying factors for young children's exposure and sensitivity to genotoxic carcinogens were not used because young children do not attend WAMS. All exposure inputs and risk calculations are included in Appendix A.

After deriving the alternative TACs, CT DPH compared them with average indoor air concentrations of TCE in the WAMS and evaluated current exposures and risks to students and teachers/staff. The average TCE concentration in the WAMS is 2 ug/m^3 (Table 1). It is based on 22 samples in 13 different locations within the two WAMS buildings. Samples were collected on all floors of the buildings during three sampling events that took place in October 2007, August 2008 and December 2008.

Table 1. Alternative Target Indoor Air Concentrations (TACs) for trichloroethylene at the Waterbury Arts Magnet School (WAMS), Waterbury, CT.

Alternative TAC (ug/m^3)	Effect	Receptor
2.12	Cancer	Student
4.84	Non-cancer	Student
1*	Background*	Teacher
6.39	Non-cancer	Teacher

* The cancer risk-based alternative TAC for teacher exposure = 0.84 ug/m^3. Since this value is less than the background-based default residential TAC of 1 ug/m^3, we use the default value of 1 ug/m^3. Average concentration of trichloroethylene in indoor air of WAMS = 2 ug/m^3 (see Attachment A).

Results

Table 1 summarizes the alternative TACs derived for the WAMS. For comparison, the Table also provides the default TAC that is currently used in Connecticut (1 ug/m^3). As Table 1 shows, the most restrictive alternative TAC is 0.84 ug/m^3 (based on exposure to teachers/staff and cancer risk). Exposures to teachers/staff results in a more restrictive TAC than exposures to students because teachers/staff have a longer exposure duration than students, who are only in the school for 7 years. The alternative TAC of 0.84 ug/m^3 is lower than the default TAC of 1 ug/m^3 that is currently used in Connecticut. Connecticut's default TAC is actually based on background indoor air levels of TCE because the risk-based value is well below background. In this case, since the most restrictive alternative TAC is below background, we use the default TAC of 1 ug/m^3 for teachers/staff. For exposures to students, the most restrictive alternative TAC is 2.12 ug/m^3 (based on cancer risk).

The average concentration of TCE in indoor air of the WAMS (2 ug/m^3) is below the alternative TAC for students but is about two times higher than the default CT TAC of 1 ug/m^3. However, the default TAC is developed based on long-term exposure (30 years). The WAMS has been open for only 7 years. To evaluate current teacher/staff exposures and risks, CT DPH calculated cumulative cancer risks to teachers/school staff based on 7 years of exposure. Details of this calculation are included in Appendix A. Based on 7 years exposure, current theoretical cancer risks to teachers/staff are about 1.25 times lower than the *de minimis* (1 in a million) excess cancer risk target.

Conclusions

The average concentration of TCE in the indoor air of WAMS is below the alternative TACs for students. Therefore, based on currently available data, TCE in indoor air of the WAMS is not expected to harm the health of students attending the school.

With regard to exposure to teachers and school staff, the average TCE concentration in indoor air of the WAMS is about two times higher than the default CT TAC of 1 ug/m^3 and the alternative TAC (based on cancer) of 0.84 ug/m^3. However, current theoretical cancer risks to teachers/staff based on a 7-year exposure period (the length of time the WAMS has been open) are about 1.25 times lower than the *de minimis* (1 in a million) excess cancer risk target. Therefore, CT DPH concludes that TCE in indoor air is unlikely to harm the health of teachers and school staff working at the WAMS. However, if current indoor air concentrations of TCE persist into the future, long-term risks will increase and after about 10 years of exposure, theoretical cancer risks will exceed the *de minimis* target risk level of one-in-one million.

Recommendations

Within the next two years, CT DPH strongly recommends that average TCE concentrations in the WAMS be reduced to a level as close as reasonably achievable to the TAC of 1 ug/m^3. There are various approaches that could be used to reduce TCE concentrations in indoor air. These approaches may include installing a sub slab ventilation system, providing additional fresh air exchange in the basement, filtering intake air, further indoor air sampling (to document natural attenuation), identifying and controlling outdoor TCE source(s), or a combination of approaches.

If you have any questions regarding the information in this letter, please contact me at 860-509-7748.

Sincerely,

Meg Harvey, Supervisor
Site Assessment and Chemical Risk Unit
Environmental and Occupational Health Assessment Program

References:

HRP, September 2008, August 2008 Quarterly Soil Gas Sampling Event and Indoor Air Quality Report, Waterbury Arts and Education Project, prepared by HRP Associates, Inc. for Naugatuck Valley Development Corporation, September 19, 2008.

HRP, December 2008, Work Plan for Soil Gas and Air Quality Investigations, Waterbury Arts and Education Project, prepared by HRP Associates, Inc. for Naugatuck Valley Development Corporation, December 4, 2008.

HRP, February 2009, December 2008, Soil Gas Sampling Event and Indoor Air Quality Report, Waterbury Arts and Education Project, prepared by HRP Associates, Inc. for Naugatuck Valley Development Corporation, February 4, 2009.

CT DEP 2003. Proposed Revisions, Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003.

ATTACHMENT A

Derivation of Alternative Indoor Air Concentration for TCE - Waterbury Arts Magnet School

Students - Trichloroethylene TAC

	Value	Unit
ATc	70	years
ATn	6	years
BW	53	kg
ED	6	years
EF	180	days/yr
IRair	20	m3/day
RfDi	3.00E-04	mg/kg-day
SFi	0.0889	risk/mg/kg-day *
THQ	1	dimensionless
TR	1.00E-06	dimensionless

For carcinogenic effects

$$TAC = \frac{TR \times BW \times ATc \times 365\ d/yr \times 1000\ ug/mg}{SFi \times IRair \times EF \times ED}$$

TAC = 0.705198309 ug/m³

Multiplied by 3 to account for 8 hr/day exposure

TAC = 2.12 ug/m³

For non-carcinogenic effects

$$TAC = \frac{THQ \times BW \times RfDi \times ATn \times 365\ d/yr \times 1000\ ug/mg}{IRair \times EF \times ED}$$

TAC = 1.612083333 ug/m³

Multiplied by 3 to account for 8 hr/day exposure

TAC = 4.84 ug/m³

* CT uses the mid-point of the 2001 USEPA cancer risk range

Teachers - Trichloroethylene

	Value	Unit
ATc	70	years
ATn	20	years
BW	70	kg
ED	20	years
EF	180	days/yr
IRair	20	m3/day
RfDi	3.00E-04	mg/kg-day
SFi	0.0889	risk/mg/kg-day *
THQ	1	dimensionless
TR	1.00E-06	dimensionless

For carcinogenic effects

$$TAC = \frac{TR \times BW \times ATc \times 365\ d/yr \times 1000\ ug/mg}{SFi \times IRair \times EF \times ED}$$

TAC = 0.279418198 ug/m³

Multiplied by 3 to account for 8 hr/day exposure

TAC = 0.84 ug/m³

For non-carcinogenic effects

$$TAC = \frac{THQ \times BW \times RfDi \times ATn \times 365\ d/yr \times 1000\ ug/mg}{IRair \times EF \times ED}$$

TAC = 2.129166667 ug/m³

Multiplied by 3 to account for 8 hr/day exposure

TAC = 6.39 ug/m³

Cancer Risks at the Average TCE Level of 2 ug/m3

	Value	Unit
ATc	70	years
BW	70	kg
ED	20	years
EF	180	days/yr
IRair	20	m3/day
SFi	0.0889	risk/mg/kg-day *
[TCE]	2	ug/m3

Teachers, 20 years exposure

$$LADD = \frac{[TCE] \times IRrair \times EF \times 1\ mg/1000\ ug \times ED \times 8\ hr/24/h}{BW \times ATc \times 365\ d/y}$$

LADD = 2.68378E-06 ug/m3

RISK = LADD x SF

RISK = 2.38E-06

	Value	Unit
ATc	70	years
ATn	20	years
BW	70	kg
ED	7	years
EF	180	days/yr
IRair	20	m3/day
RfDi	3.00E-04	mg/kg-day
SFi	0.0889	risk/mg/kg-day *
[TCE]	2	ug/m3

Teachers, 7 years exposure

$$LADD = \frac{[TCE] \times IRrair \times EF \times 1\ mg/1000\ ug \times ED \times 8\ hr/24/h}{BW \times ATc \times 365\ d/y}$$

LADD = 9.39326E-06 ug/m3

RISK = LADD x SF

RISK = 8.4E-07

	Value	Unit
ATc	70	years
ATn	20	years
BW	70	kg
ED	10	years
EF	180	days/yr
IRair	20	m3/day
RfDi	3.00E-04	mg/kg-day
SFi	0.0889	risk/mg/kg-day *
[TCE]	2	ug/m3

Teachers, 10 years exposure

$$LADD = \frac{[TCE] \times IRrair \times EF \times 1\ mg/1000\ ug \times ED \times 8\ hr/24/h}{BW \times ATc \times 365\ d/y}$$

LADD = 1.34189E-06 ug/m3

RISK = LADD x SF

RISK = 1.2E-06

Average Indoor Air Concentration, TCE (samples collected October 2007, August 2008, December 2008)

Sample ID	Conc (ug/m3)
1A-1	3.5
1A-2	3.5
1A-2D	0.68
1A-3	3
1A-7D	0.53
1A-10D	0.99
1A-4	4.3
1A-4D	2
1A-5	3
1A-13D	1.7
1A-6	3.2
1A-6D	1.9
1A-2C	1.7
1A-7C	1.4
1A-8C	1.5
1A-9C	1.4
1A-10C	1.6
1A-4C	1.8
1A-6C	1.9
1A-11C	1.8
1A-12C	1.9
1A-13C	1.8
Ave	2.05

CERTIFICATION

The letter health consultation for the Waterbury Arts Magnet School was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the letter health consultation was initiated. Editorial review was completed by the cooperative agreement partner.

Technical Project Officer, CAT, CAPEB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation, and concurs with its findings.

Team Leader, CAT, CAPEB, DHAC, ATSDR